ONKYO SERVICE MANUAL

SYNTHESIZED FM/AM STEREO TUNER MODEL T-4015

UD, UDN, BUD, BUDN	120V AC, 60Hz
UG, UGV, BUG, BUGV	220V AC, 50Hz
UW	120 or 220V AC, 50/60Hz

SAFETY-RELATED COMPONENT WARNING!!

COMPONENTS IDENTIFIED BY MARK ⚠ ON THE SCHEMATIC DIAGRAM AND IN THE PARTS LIST ARE CRITICAL FOR RISK OF FIRE AND ELECTRIC SHOCK. REPLACE THESE COMPONENTS WITH ONKYO PARTS WHOSE PARTS NUMBERS APPEAR AS SHOWN IN THIS MANUAL.

MAKE LEAKAGE-CURRENT OR RESISTANCE MESUREMENTS TO DETERMINE THAT EXPOSED PARTS ARE ACCEPTABLY INSULATED FROM THE SUPPLY CIRCUIT BEFORE RETURNING THE APPLIANCE TO THE CUSTOMER.

SPECIFICATIONS

D model
FM:

Tuning Range:	87.5 – 108.0 MHz (100 kHz steps)
Usable sensitivity:	Mono: 10.8 dBf, 1.9 μV, 1HF Stereo: 17.2 dBf, 4.0 μV
50 dB Quieting Sensitivity:	Mono: 16.1 dBf, 3.5 μV Stereo: 36.1 dBf, 35 μV
Capture Ratio:	1.3 dB
Image Rejection Ratio:	40 dB
IF Rejection Ratio:	90 dB
Signal-to-Noise Ratio:	Mono: 75 dB Stereo: 68 dB
Alternate Channel Att:	55 dB 1HF (±400 kHz)
AM Suppression Ratio:	50 dB
Total Harmonic Dist:	Mono: 0.1% Stereo: 0.2%
Frequency Response:	30 – 15,000 Hz ± 1.5 dB
Stereo Separation:	40 dB at 1 kHz 30 dB at 70-10,000 Hz
Output Voltage:	0.6 V
Muting Level:	17.2 dBf, 4.0 μV

ONKYO
AUDIO COMPONENTS

AM:

Tuning Range:	520-1710 kHz (10 kHz steps)
Usable Sensitivity:	25 μV
Image Rejection Ratio:	40 dB
IF Rejection Ratio:	30 dB
Signal-to-Noise Ratio:	40 dB
Total Harmonic Distorition:	0.8%
Output Voltage:	150 mV

General

Antennas:	FM: 300 ohm balanced and 75 ohm unbalanced AM: Built-in loop antenna and external terminal
Semiconductors:	FETs: 6 TR: 29 ICs: 9 Diodes: 43 LEDs: 19
Dimensions (W×H×D):	435 x 77 x 373 mm (17-1/8" x 3" x 14-3/4")
Weight:	4.5 kg., 9.9 lbs.

G/W model

FM:

Tuning Range:	87.5 – 108.0 MHz (50 kHz steps)
Usable sensitivity:	Mono: 10.8 dBf, 1.9 μV, 1HF Stereo: 17.2 dBf, 4.0 μV
50 dB Quieting Sensitivity:	Mono: 16.1 dBf, 3.5 μV Stereo: 36.1 dBf, 35 μV
Capture Ratio:	1.3 dB
Image Rejection Ratio:	90 dB
IF Rejection Ratio:	90 dB
Signal-to-Noise Ratio:	Mono: 75 dB Stereo: 68 dB
Selectivity:	60 dB DIN (±300 kHz, 40 kHz dev.)
AM Suppression Ratio:	50 dB
Total Harmonic Dist:	Mono: 0.1% Stereo: 0.2%
Frequency Response:	30 – 15,000 Hz ± 1.5 dB
Stereo Separation:	40 dB at 1 kHz 30 dB at 70-10,000 Hz
Output Voltage:	1.0 V
Muting Level:	17.2 dBf, 4.0 μV

AM:

Tuning Range:	522-1611 kHz (9 kHz steps)
Usable Sensitivity:	25 μV
Image Rejection Ratio:	40 dB
IF Rejection Ratio:	30 dB
Signal-to-Noise Ratio:	40 dB
Total Harmonic Distortion:	0.8%
Output Voltage:	150 mV
Antennas:	FM: 300 ohms balanced and 75 ohms unbalanced AM: Built-in loop antenna and external terminal
Semiconductors:	FETs: 6 TR: 32 ICs: 9 Diodes: 47 LEDs: 19
Dimensions (W×H×D):	435 x 77 x 373 mm (17-1/8" x 3" x 14-3/4")
Weight:	4.5 kg., 9.9 lbs.

Specifications and features are subject to change without notice.

SERVICE PROCEDURES

1. Replacing the lamps

This unit uses the lamps listed below.

circuit no.	parts no.	description
PL901	210064A	PL6.3V 250mA, dial plate illumination
PL902	210149	PL14V 0.06AW-3.0, Power indicator

Caution; Before replacing the lamps, be sure to unplug the power supply cable.

2. Insulation resistance mesurement

Connect the insulating-resistance tester between the plug of power supply cable and the nickel screw on the back panel. (See fig. 1)

Specifications; D model 500V, 3.3 ± 0.3MΩ
G/W models 500V, more than 10MΩ

3. Handling the CMOS IC

This unit uses the CMOS ICs of Q202, Q702 and Q709.

1. All MOS devices should be store transported in materials that are somewhat conductive. MOS devices must not be inserted into conventional plastic "snow" or plastic trays.
2. All MOS devices should be placed on a grounded bench surface and operators should ground themselves prior to handling devices, since a worker can be statically charged with respect to the bench surface.
3. Nylon clothing should not be worn while handling MOS circuit.
4. When lead straightening or hand soldering is necessary, provide ground straps for the apparatus used.
5. Double check test equipment setup for proper polarity of voltage before conducting parametric or functional testing.
6. All unused device inputs should be connected to V_{DD} or V_{SS} (Ground).

4. Change of AM scan step

W models are equipped with a switch to change the AM scan step frequency from 9kHz to 10kHz. This switch is located on the bottom board. This switch is set to 9kHz at the factory; change to 10kHz if gives better results in your locality.

5. Change of De-emphasis

W models are equipped with a 50μsec-75μsec selector switch. This switch is located on the bottom board. This switch is set to 50μsec at the factory, but may have to be reset to 75μsec depending on the area where the unit is used.

Europe: 50μsec
U.S.A.: 75μsec

6. Change of voltage

W models are equipped with a voltage selector to conform with local power supplies. This switch is located on the back panel. Be sure to set this switch to match the voltage of the power supply in your area before turning the power switch on.

This switch is set to 220V at the factory. Voltage is changed by sliding the groove in the switch with the screwdriver to the right or left. Confirm that the switch has been moved all the way to the right or left before turning the power switch on.

7. Memory Preservation

This unit does not require memory preservation batteries. A built-in memory power back-up system preserves contents of the memory during power failures and even when the unit is unplugged. The unit must be plugged in and the power switch turned on and off once in order to charge the back-up system. Note that since this is not a permanent memory, the power switch must be turned on and off a few times each month to keep the back-up system operable. The period of time during which memory contents are preserved after power has last been turned off varies depending on climate and the location and placement of the unit. On the average, memory contents are protected over a period of 3 to 4 weeks (a minimum of 2 weeks) after the last time power has been turned off. This period is shorter when the unit is exposed to very high humidity or used in an area with an extremely humid climate.

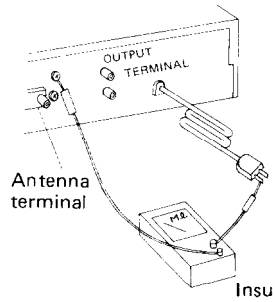


fig. 1

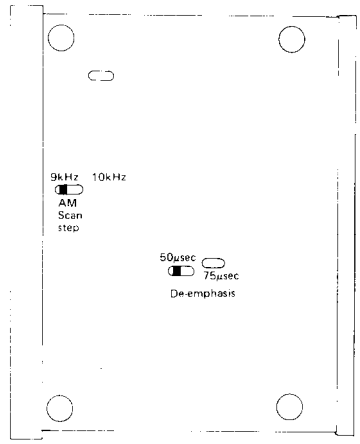
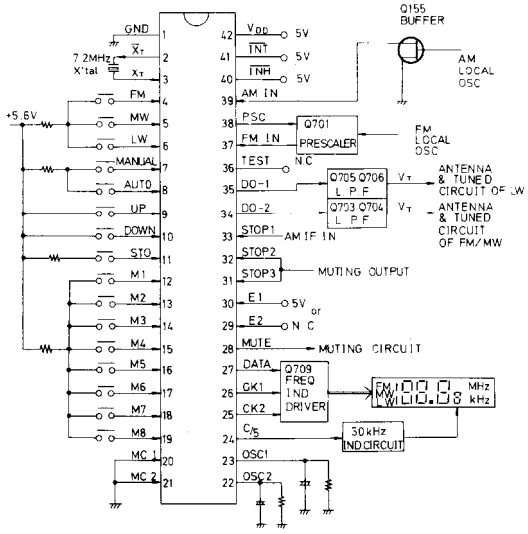


fig. 2 Bottom view

CIRCUIT DESCRIPTIONS

1. Synthesizer and controller operation



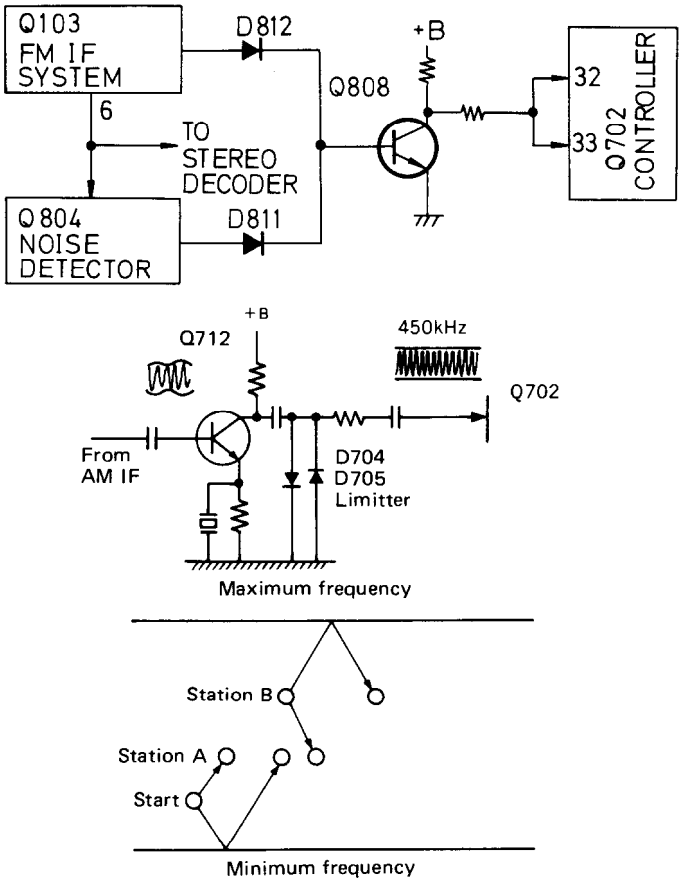
Pin No.	Symbol	Terminal	Description
1	GND	Ground	
2	XT	X'tal	Connected to the 7.2MHz crystal oscillator for the reference frequency.
3	XT		
4	FM	FM band specification input	Mutual reset type, performs switching of each band, FM/MW/LW.
5	MW	MW band specification input	
6	LW	LW band specification input	
7	MANUAL	Manual tuning mode specification input	Mutual reset type, performs auto search and manual operation mode switching during UP/DOWN tuning.
8	AUTO	Auto search tuning mode specification input	
9	UP	UP tuning key input	Connect the push key and perform UP/DOWN tuning.
10	DOWN	DOWN tuning key input	
11	STO	Memory store command input	The preset memory is set to the write mode when the key is pressed.
12-19	M1-M8	Preset memory channel specification input	Controls the write and read out of the internal 16-station preset memory along with the MC1 and MC2 input.
20	MC-1	Memory control input	Set the 16-station preset memory to the 8 FM/8 AM station mode or the FM/MW/LW 3-band 16-station random mode. The 8 FM/8 AM mode is used in this unit.
21	MC-2		
22	OSC2	AM oscillator terminal	CR connection terminal for the oscillator that determines the scan speed during the AM search mode.
23	OSC1	FM oscillator terminal	CR connection terminal for the oscillator that determines the scan speed during the FM search mode.
24	0/5	FM 50 kHz output	Output that represents the 50kHz FM band tuning step for European models. Goes to the high level for the 50 kHz setting.

Pin No.	Symbol	Terminal	Description
25	CK2	Tuned frequency data output	Outputs the serial data and timing clock to the tuned frequency display driver.
26	CK1		
27	DATA		
28	MUTE	Muting signal output	Goes to the high level during muting output.
29	E2	Regin specification input	See table 1.
30	E1		
31	STOP 3	AM IF signal input	During AM reception, this counts the IF signal and stops auto search.
32	STOP 2	Auto search stop signal input	When the stop 1 input (pin 33) is at the high level and this terminal goes to the high level, auto search is stopped.
33	STOP 1	Scan speed slow input	When the high level is input at this terminal, the auto search speed is cut in half.
34	DO1	Error output	Charge pump output of the phase detector which constitutes the PLL. High level is output when the divided oscillation frequency is high than the reference frequency. In the opposite case, low level is output. Floating occurs when the frequencies match. The output is applied to the variable capacitor diode in the front end through low pass filter Q703 and Q704. The output from both terminals is the same, but only D01 is used.
35	D02		
36	TEST	Test terminal	Test mode at the high level.
37	FM IN	FM programmable counter input	Connect to the prescaler output (Pin3 of Q701)
38	PSC	Pulse swallow control output	Output to the control the division ratio of the prescaler.
39	AM IN	AM local oscillator signal input	Terminal for input of AM broadcast signal.
40	$\overline{INH}$	Inhibit input	Operates normally at the high level. Inhibit status at the low level.
41	$\overline{INT}$	Initialize input	Operates normally at the high level. At the low level, the internal status is initialized.
42	V_{DD}	Power suuply	Device power terminal; supplies 5V during the normal operation and 2.5V from the super capacitor (C714) for memory preservation.

E1 (Pin 30)	E2 (Pin 29)	Regin	Band	Frequency range	Intermediate frequency	Scan step	Reference frequency
0	1	U.S.A	FM	87.5 ~ 108.0 MHz	+10.7 MHz	100 kHz	25 kHz
			AM1	520 ~ 1 710 kHz	+450 kHz	10kHz	10 kHz
1	1		AM2	522 ~ 1710 kHz	+450 kHz	9kHz	9kHz
1	0	Europe	FM	87.50 ~ 108.00 MHz	+10.7 MHz	50 kHz	25 kHz
			MW	522 ~ 1611 kHz	+450 kHz	9 kHz	9 kHz
			LM	153 ~ 360 kHz	+450 kHz	1 kHz	1 kHz
0	0	Japan	FM	76.0 ~ 90.0 MHz	- 10.7 MHz	100 kHz	25 kHz
			AM	522 ~ 1611 kHz	+450 kHz	9 kHz	9 kHz

Table 1

2. Auto-search tuning circuit

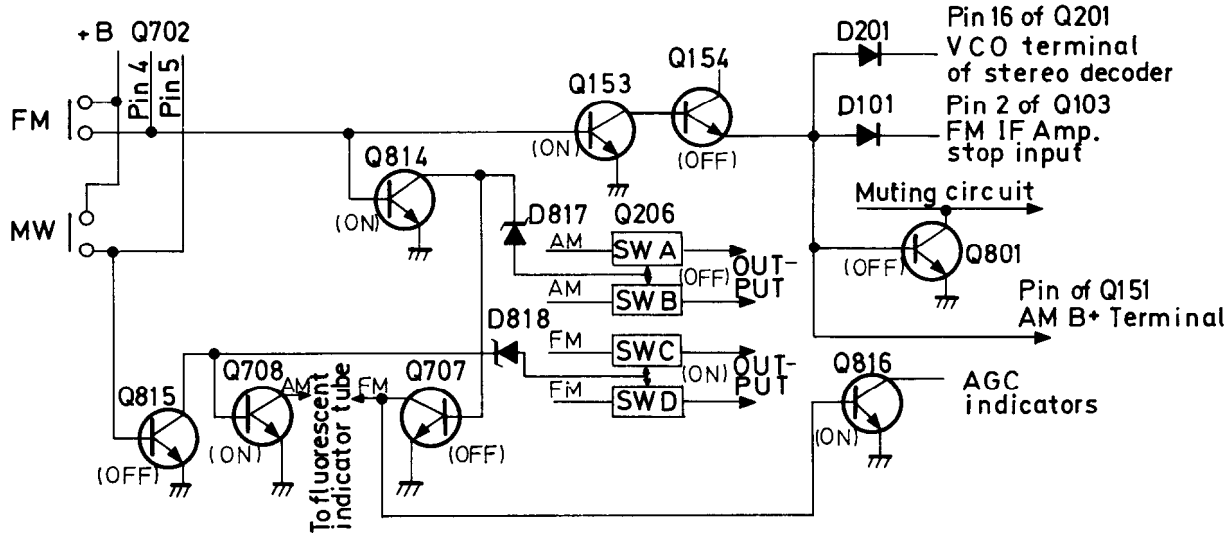


During FM reception, this is operated by the IF level detection and zero point detection circuits included in the FM IF system IC of Q103 and by the noise component detection circuit of Q804. When a station is tuned, the output of all outputs go to the low level so Q808 goes from on to off, causing pins 32 and 33 of the controller IC to go to the high level to complete auto search tuning.

During AM reception, the AM IF signal is taken, amplified by Q712, limited to a certain amplitude by the D704 D705 limiter circuits and auto search tuning is completed when the IF signal becomes 450 ± 3 kHz.

- **Manual Tuning**
  When the UP or DOWN key is pressed, the frequency goes up or down by one step. When either key is held down, the frequency rapidly increases or decreases (scans) and stops when the key is released. When either end of the tuning range is reached, key input will no longer be received and the frequency will stop at the highest or lowest frequency.
- **Auto Tuning**
  When the UP or DOWN key is pressed, scanning begins in the up or down direction, stopping where there is a radio station. Since auto scan is operated by a triangular wave, scanning is begun in the opposite direction the instant either end of the tuning range is roached. Also, if the UP or DOWN key is pressed when the tuned frequency is not at either end of the range, up or down scanning will begin.

3. FM/AM selector circuit

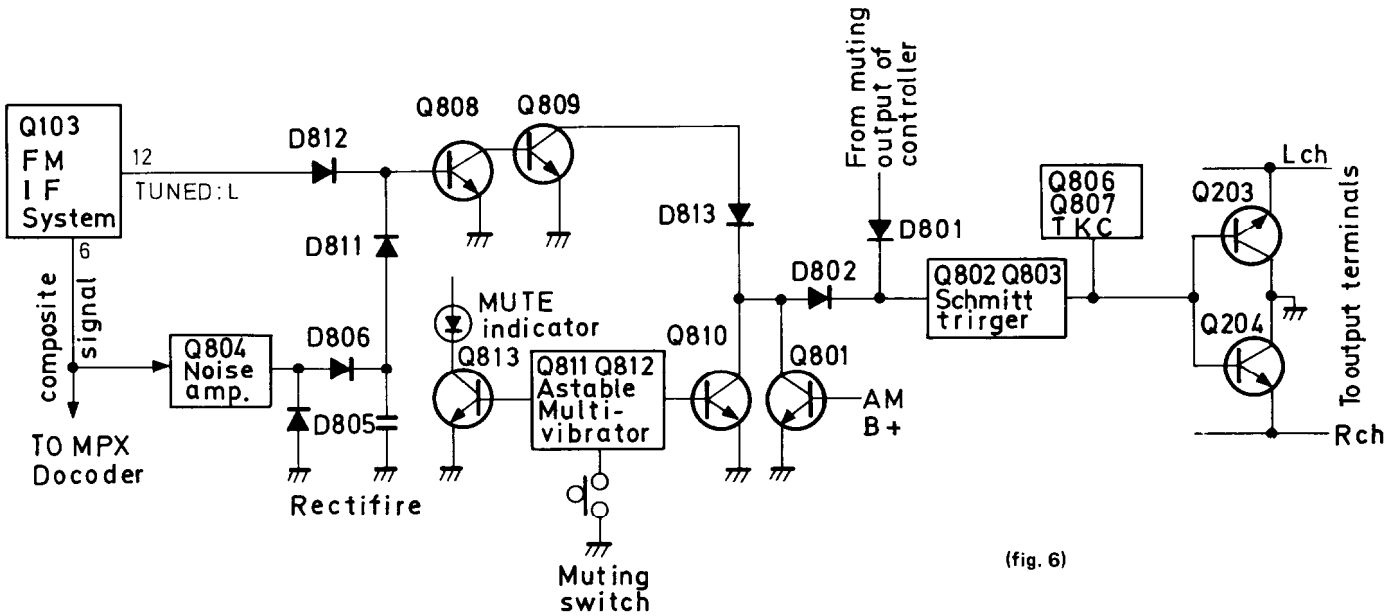


(fig. 5)

The FM/AM selector circuit is shown in the diagram. fig. 5. Pins 4 and 5 of Q702 are of the mutual reset type. For FM, pin 4 is high and pin 5 is low; for AM, pin 4 is low and pin 5 is high. Because pin 5 is high and pin 4 is low during AM reception, Q815 is on and Q814 is off, the analog switches SW1 and SW2 of Q202 are on while SW3 and SW4 are off, so an AM signal is output. Also, since Q708 goes to on and Q707 to off, the AM, kHz segments of the fluorescent display are turned on. Q816 goes to off so the DX/LOCAL indicator is turned off. At the same time, Q153 is turned off and Q152 turned on, so +B is supplied to the power source terminal of the radio system pin 3 of Q151.

Pin 16 of Q201 goes to the high level, the VCO oscillator stops, and pin 2 of Q103 goes to the high level so the FM IF amp is also switched off. Also, during AM reception, Q801 is turned on so the muting circuit is off. During FM reception, all of the switching transistors mentioned above perform the opposite operations to switch to the FM mode. Figures in parenthese indicate transistor operation during FM reception.

4. Muting circuit



(fig. 6)

The muting circuit operates in the following cases.

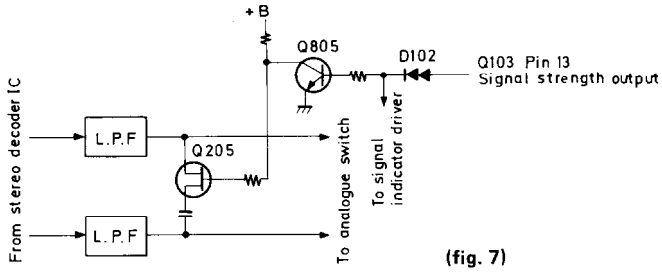
1. When power is turned on, the charging current goes from B+ to R824 to C810, so Q807 is cut off and Q203 and Q204 are turned on. When the voltage at both ends of C810 is more than about 0.6V, Q807 is turned on so Q203 and Q204 are turned off and muting is opened.
2. When power is turned off, Q806 turns off, the discharging current goes from C809 to R821 to D809 to Q203 and Q204 so muting is closed.
3. While pin 28 of the controller IC outputs the high level, Q203 and Q204 are turned on and muting is closed in the following cases: (1) While the manual UP/DOWN switch is being held down, (2) When a station in the memory is recalled, and (3) While a radio station is being received using auto search tuning.
4. When an FM station is not being received (and the muting switch is on).
   The IF level in the FM IF system (set at R124 so muting is opened at 17 dBf) and zero point detection circuit (tuning point ±50kHz) are output at pin 12 through the AND circuit. When a station is tuned, the output goes to the low level. In addition, the noise components over 100kHz included in the composite signal are detected by the noise amp of Q804. If there is no noise, the output goes to the low level.

When either output goes to the low level, Q808 is turned off, Q809 is turned on, Q802 is turned off, Q803 is turned on and Q203 and Q204 are turned off, so muting is opened;

Muting Switch Circuit

An astable multi-vibrator is used in the muting switch circuit. When power is turned on, Q811 is turned on and Q812 is turned off so Q810 is turned off and Q813 is turned on, the MUTE/MODE indicator lights and the muting circuit operates. When the MUTE/MODE switch is pressed, the transistors listed above operate in the opposite manner and the input of the schmitt trigger goes to the low level so the output level also goes to low to turn off Q203 and Q204 and open muting.

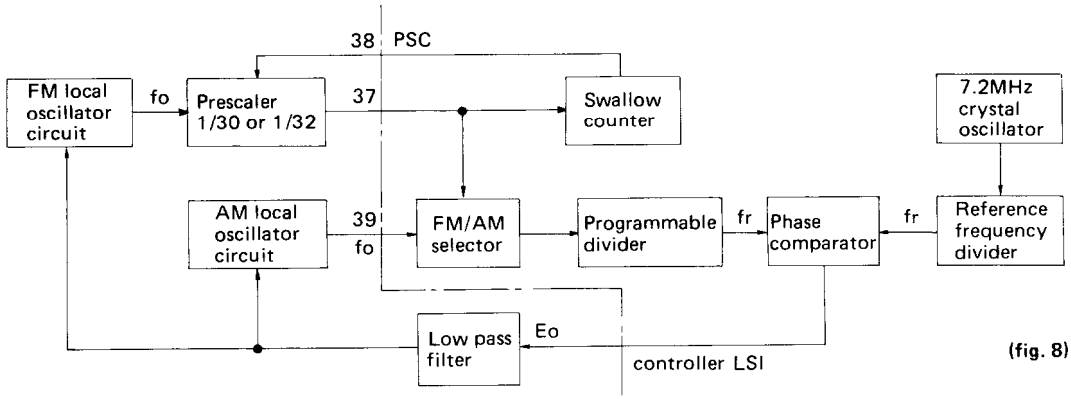
5. Auto-Hi-blend circuit



(fig. 7)

There is a 3-stage IF level detection circuit in the IC of Q103. A direct current voltage approximately proportional to the electrical field intensity is output from output pin 13. This is used to turn off Q805 and turn on Q205 when the electrical field is weak and, making use of the fact that the phase of noise components in the high range of stereo broadcasts is reversed left-right, the left and right channels are mixed in the high range to reduce noise.

6. PLL tuned circuit



(fig. 8)

A block diagram of the tuned circuit of the PLL is shown in figer 8.

Operation during AM reception

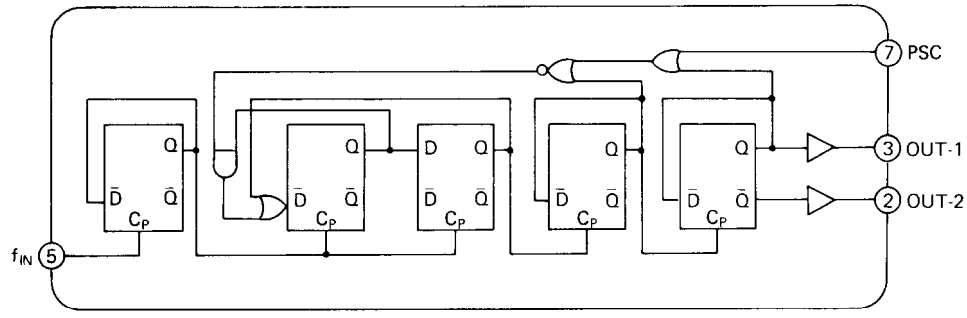
The reception frequency is applied to the programmable divider where it is divided to 1/N and output as fv. This is applied to the phase comparator where it is comparated with frequency reference fr (9kHz for G/W model and 10kHz for D model). If fr and fv differ, Eo equal to the difference in frequency is output. Since error output Eo is a pulse waveform, it is passed through the low pass filter to change it into DC voltage V_D, which is applied to the variable capacitor diode in the front end to change the reception frequency. This continues until fv and fr are the same and $E_O=0$.

Operation during FM reception

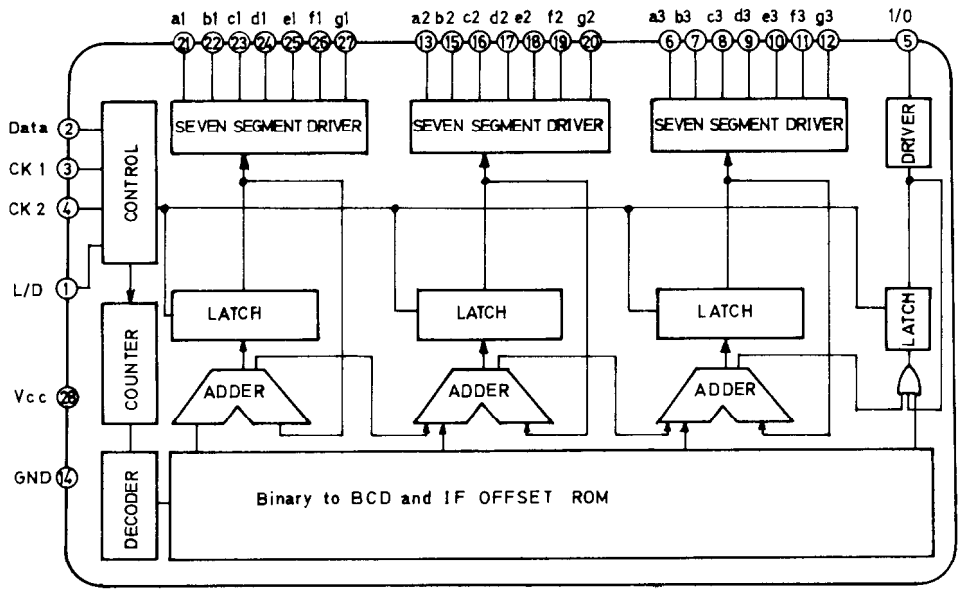
The pulse swallow method is used in the prescaler of the T-4015. In this type of prescaler, a supplementary number (changed according to the program code input) and the divided reception frequency from the prescaler are combined in the control counter and the prescaler's division factor is switched 1/30 or 1/32 according to external control (1/32 when the PSC terminal is "H" and 1/30 when it is "L").

The station oscillator frequency is applied ot the programmable divider, but the programmable divider has en upper frequency limit of only 30MHz, so the pulse swallow-type prescaler, which can be used up to 150 MHz, is inserted for division to 1/Np;

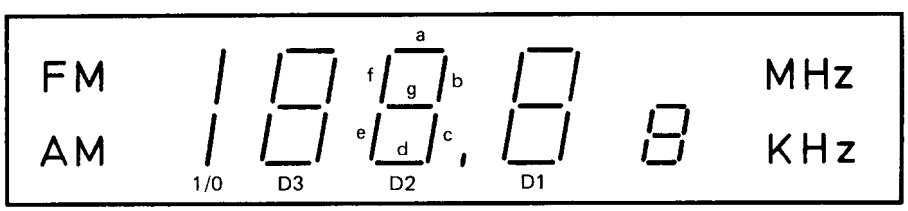
The signal is then divided to 1/2 in the controller ISI and applied to the programmable divider and divided to 1/N. The result is compared with a 25kHz frequency reference in the phase detector and the error is output as Eo until a match is obtained as in AM operation.



7. Frequency indicator circuit

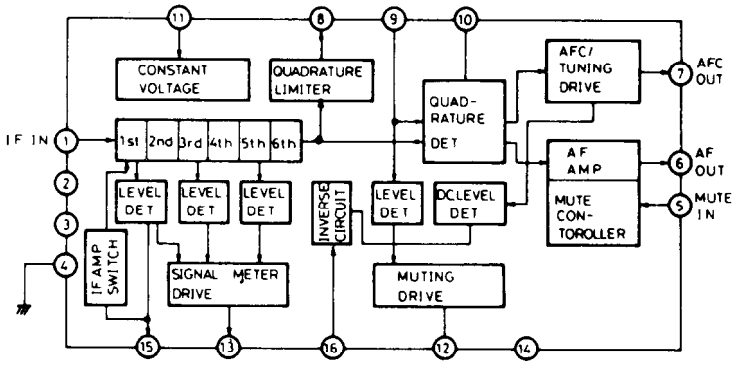


Pin No.	Terminal	Description
1	L/D	Output indication switching input terminal: Fluorescent display at the low level, and LED display at the high level.
2	Data	Tuned frequency data input terminal: Input from the system controller LSI to the serial.
3,4	CK1, CK2	Tuned frequency data input control timing input terminal: Transferred simultaneously with data from the system controller LSI.
5	1/0	Segment drive output terminal: Sets the number of display digit for FM (100MHz) and AM (1,000kHz) reception.
6-12	a3-g3	Seven segment drive output terminals: Sets the number of display digit for FM(10MHz) and AM (100kHz) reception.
13, 15-20	a2-g2	Seven segment drive output terminals: Sets the number of display digit for FM (1MHz) and AM (10kHz) reception
21-27	a1-g1	Seven segment drive output terminals; set the number of display digit for FM (100kHz) and AM (1kHz) reception
14	Vcc	Power source terminal
28	Gnd	Ground



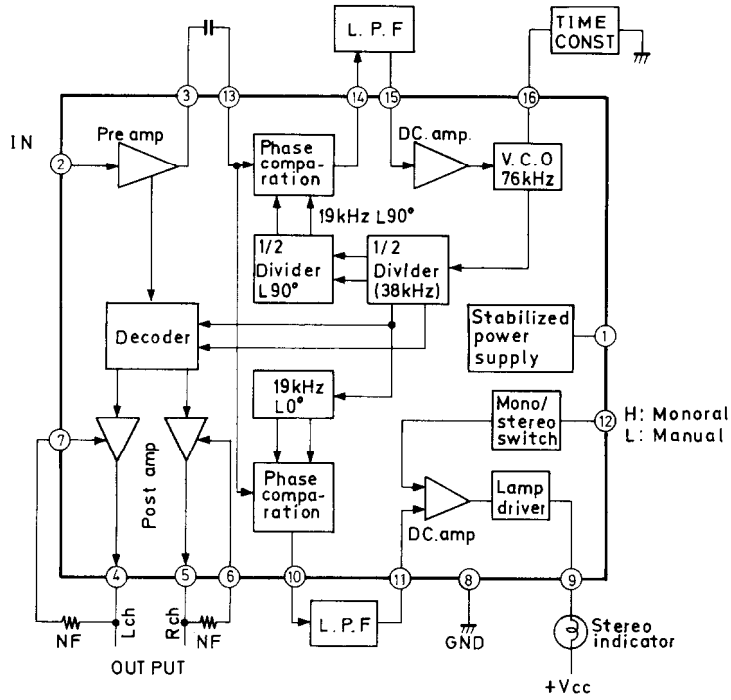
BLOCK DIAGRAM OF LINEAR IC

μPC1167C2 (FM IF system)

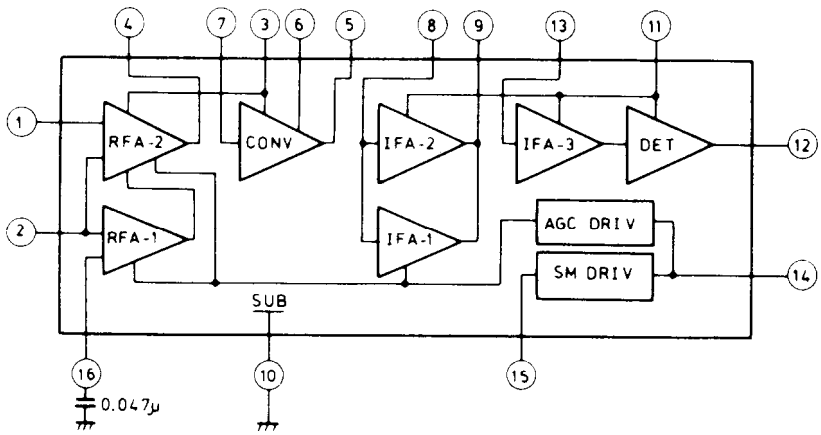


1. IF signal input
2. IF amplifier switch input
   H level: Off
5. Muting switch input
6. Composite signal output
7. AFC output
8. IF amplifier output
9. 10.7MHz input
10. Reference voltage
11. Power supply
12. Muting output
    Tuned: L level
13. Signal strength output
15. AGC output
16. Muting level

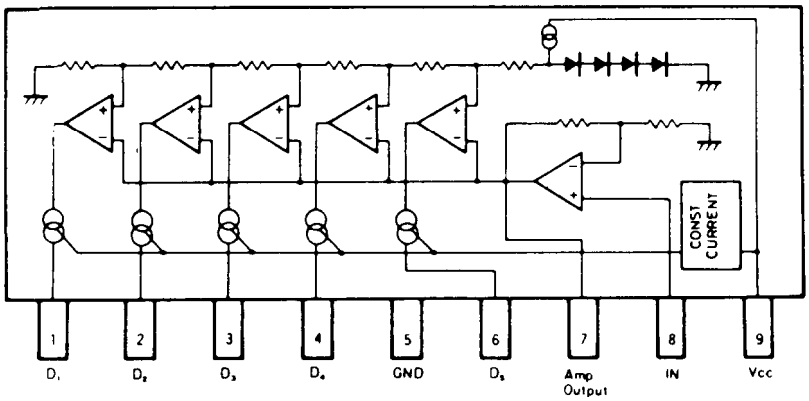
HA1196 (Stereo decoder)



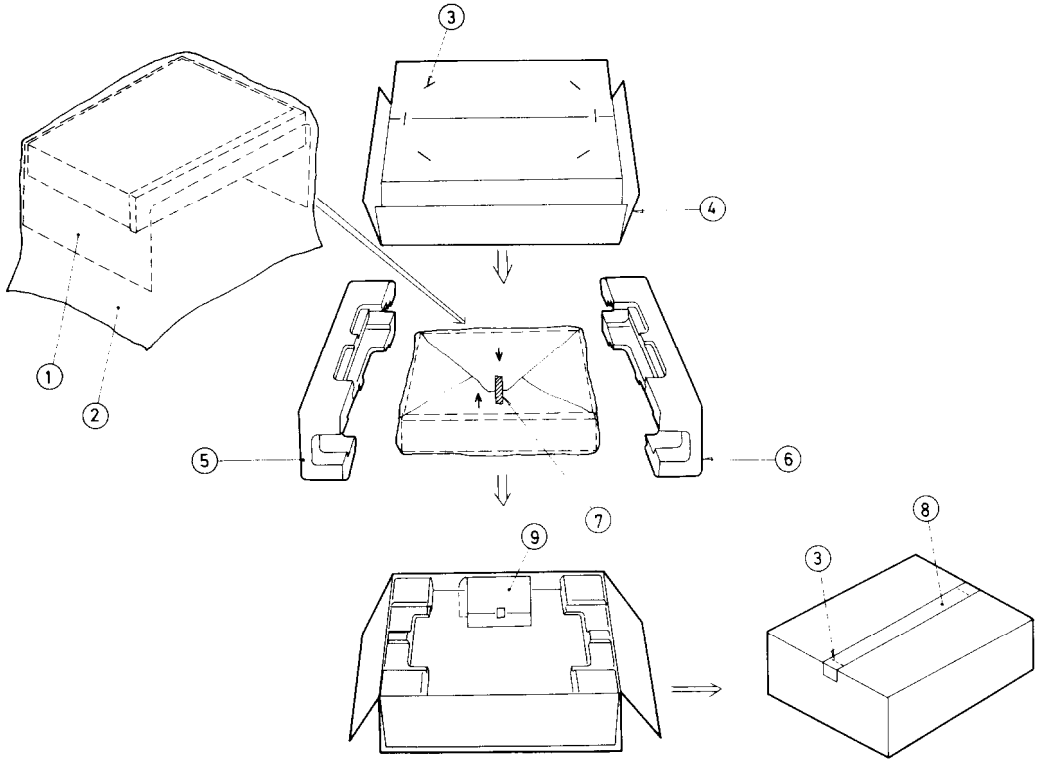
HA1197 (AM radio system)



LB1403 (Signal strength indicator driver)



PACKING VIEW

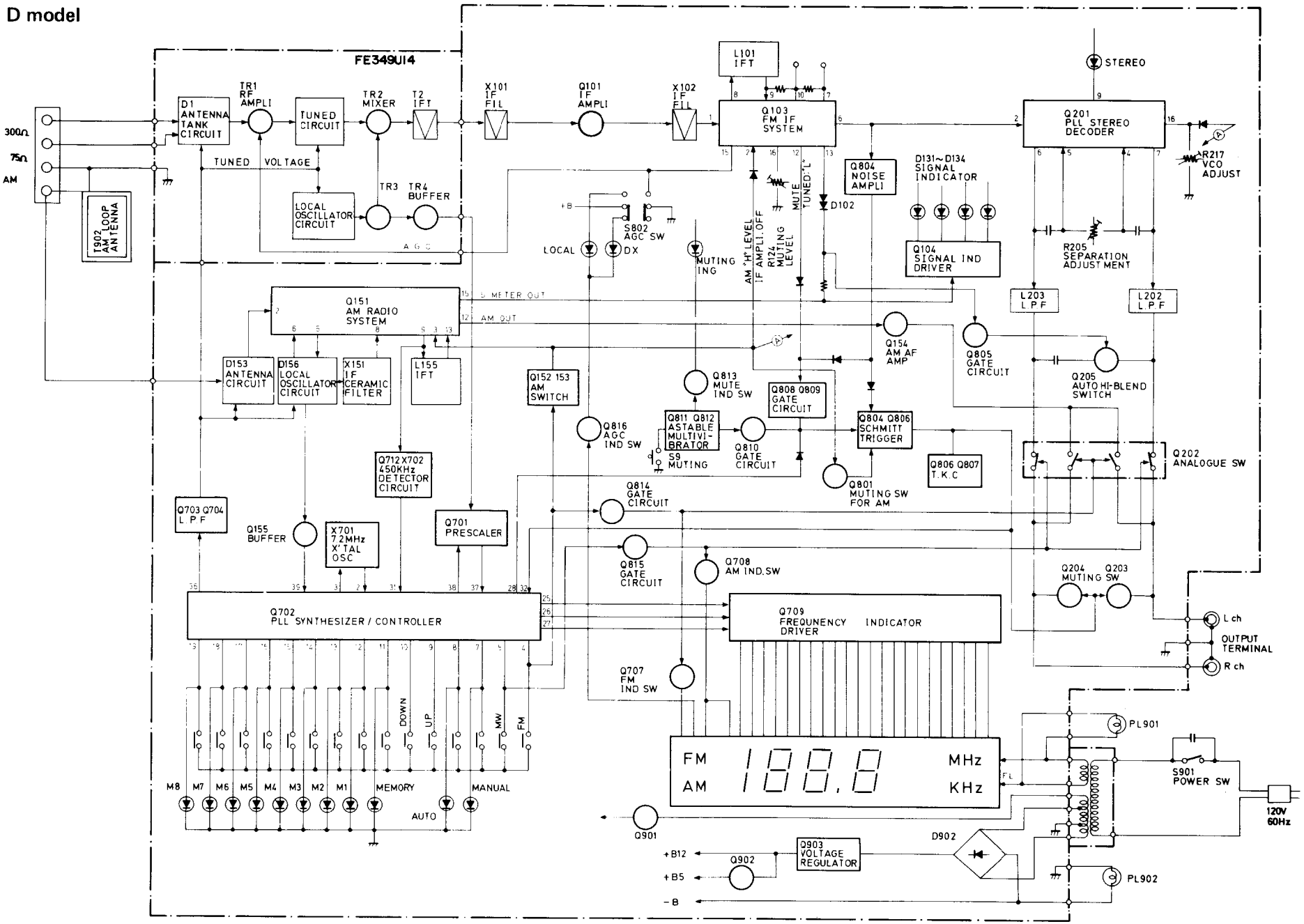


REF. NO.	PARTS NO.	DESCRIPTION
1	29095012-1	500x800mm, Protection sheet
2	29100036A	550x850mm, Poly-vinyl bag
3	282301	Sealing hook
4	29050650	Master carton box
	29050651	Master carton box (B)
5	29090772	Pad R
6	29090771	Pad L
7	2910032	W=15mm, Adhesive tape
8	260012	50(W)x700mm, Damplon tape
9	Accessary bag complete	
	U.S.A. model	
	292064A	FM antenna
	253074	Connection cable
	29340667	Instruction manual
	29365006-5	Warranty card
	29358002	Service station list
	120V model	
	292064A	FM antenna
	253074	Connection cable
	29340677	Instruction manual
	West Germany model	
	292064A	FM antenna
	253074	Connection cable
	29340678	Instruction manual
	29365005-3A	Warranty card
	29358004	Service station list
	220V model	
	292064A	FM antenna
	253074	Connection cable
	29340678	Instruction manual
	120/220V model	
	292064A	FM antenna
	253074	Connection cable
	29340678	Instruction manual
	25055040	CV-K-2, Conversion plug

Note: (B): Only black model

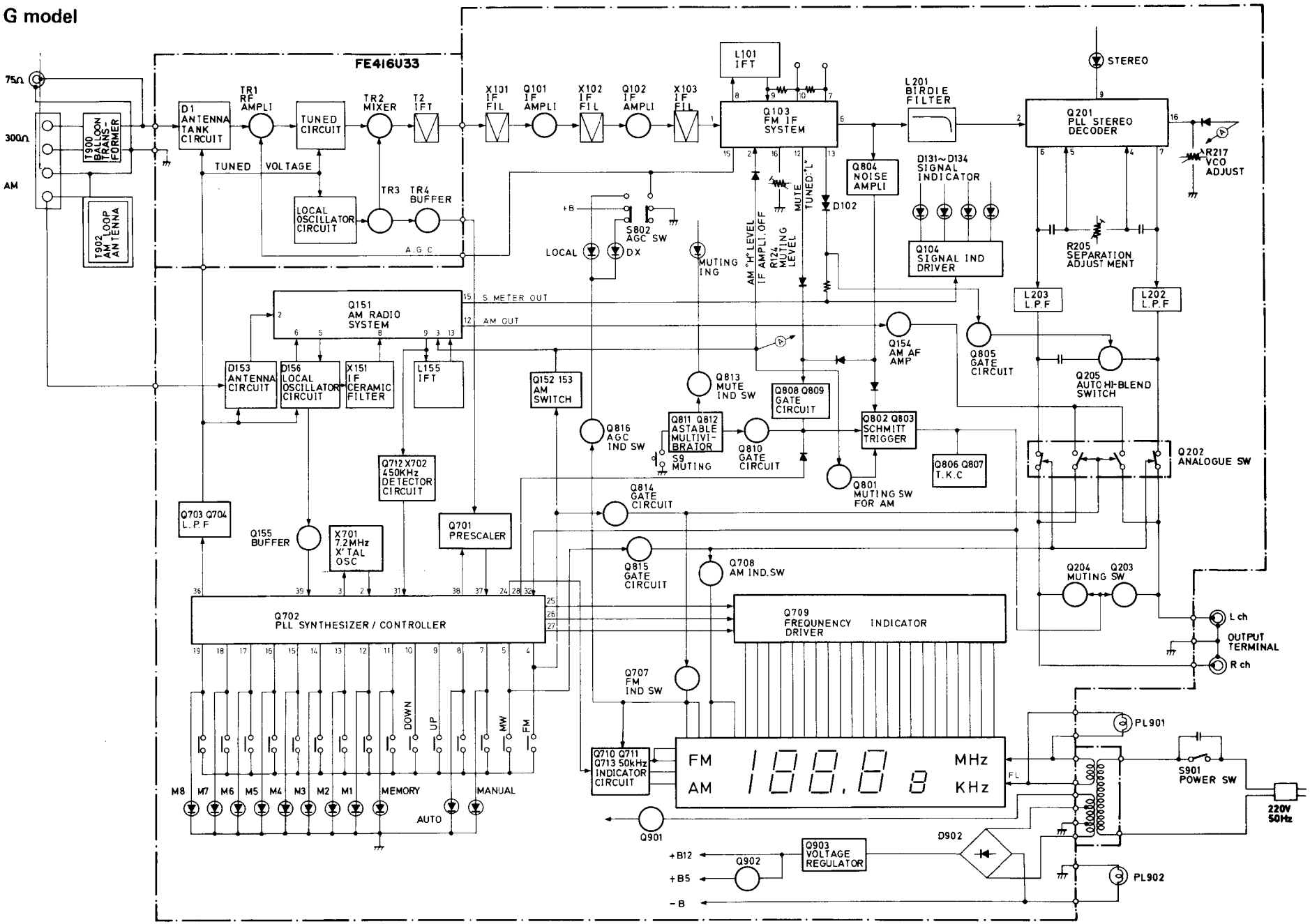
BLOCK DIAGRAM

D model



BLOCK DIAGRAM

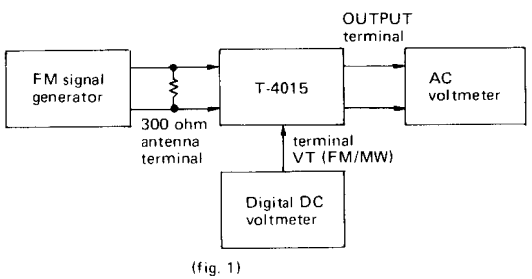
G model



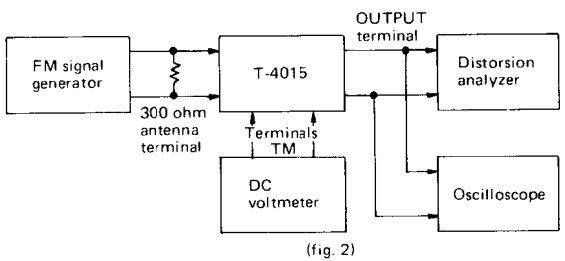
ADJUSTMENT PROCEDURES

FM section

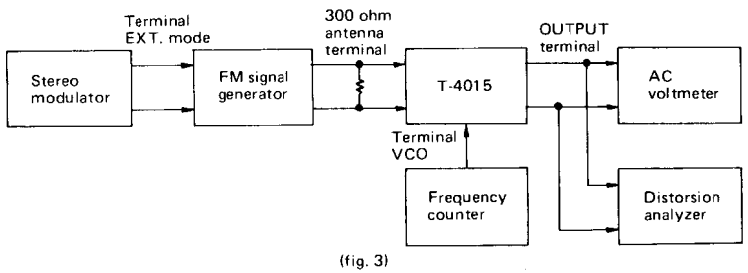
Item	Step	Connection of instrument	FM SG output	Stereo modulator output	Turning dial setting	Output indicator	Adjustment	Adjust for	Remarks
FM RF	1	Fig. 1	—	—	88.0 MHz	Digital DC voltmeter	T1	1.4V	
	2	Fig. 1	107.9 MHz 1 kHz, 75 kHz devi.	—	107.9 MHz	AC voltmeter	TC1, TC2	Maximum output	
FM IF	1	Fig. 2	—	—	No input signal	DC voltmeter	L101 Primary coil	0V	Repeat the steps 1 and 2 until no further adjustment is necessary
	2	Fig. 2	98.1 MHz 1 kHz, 75 kHz devi. 65 dBf (60 dB)	—	98.1 MHz	Distorsion analyzer	L101 Secondary coil	Minimum	
VCO		Fig. 3	98.1 MHz No modulation 65 dBf (60 dB)	—	98.1 MHz	Frequency counter	R217	76 kHz ± 76 Hz	Remove the frequency counter after adjustment
Separation	1	Fig. 3	98.1 MHz 65 dBf (60 dB) Ext. modulation	L ch. 1 kHz	98.1 MHz	R ch. AC voltmeter	R205	Minimum	Maximum and same separation
	2			R ch. 1 kHz		L ch. AC voltmeter		Minimum	
Distorsion		Fig. 3	98.1 MHz 65 dBf (60 dB) Ext. modulation	L+R 1 kHz	98.1 MHz	Distorsion analyzer	T2	Minimum	
Muting level	1	Fig. 2	98.1 MHz 17.2 dBf (12 dB) 1 kHz, 75 kHz devi.	—	98.1 MHz	Oscilloscope	R124	Signal output	Muting switch to on.
	2		98.1 MHz 16.2 dBf (11 dB) 1 kHz, 75 kHz devi.					No output	



(fig. 1)



(fig. 2)

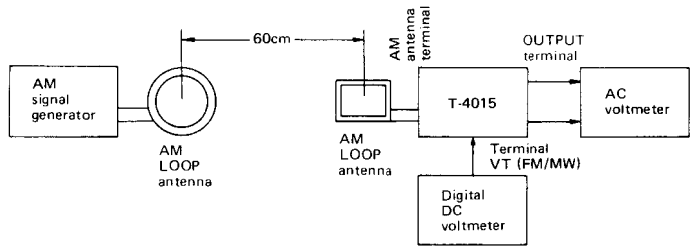


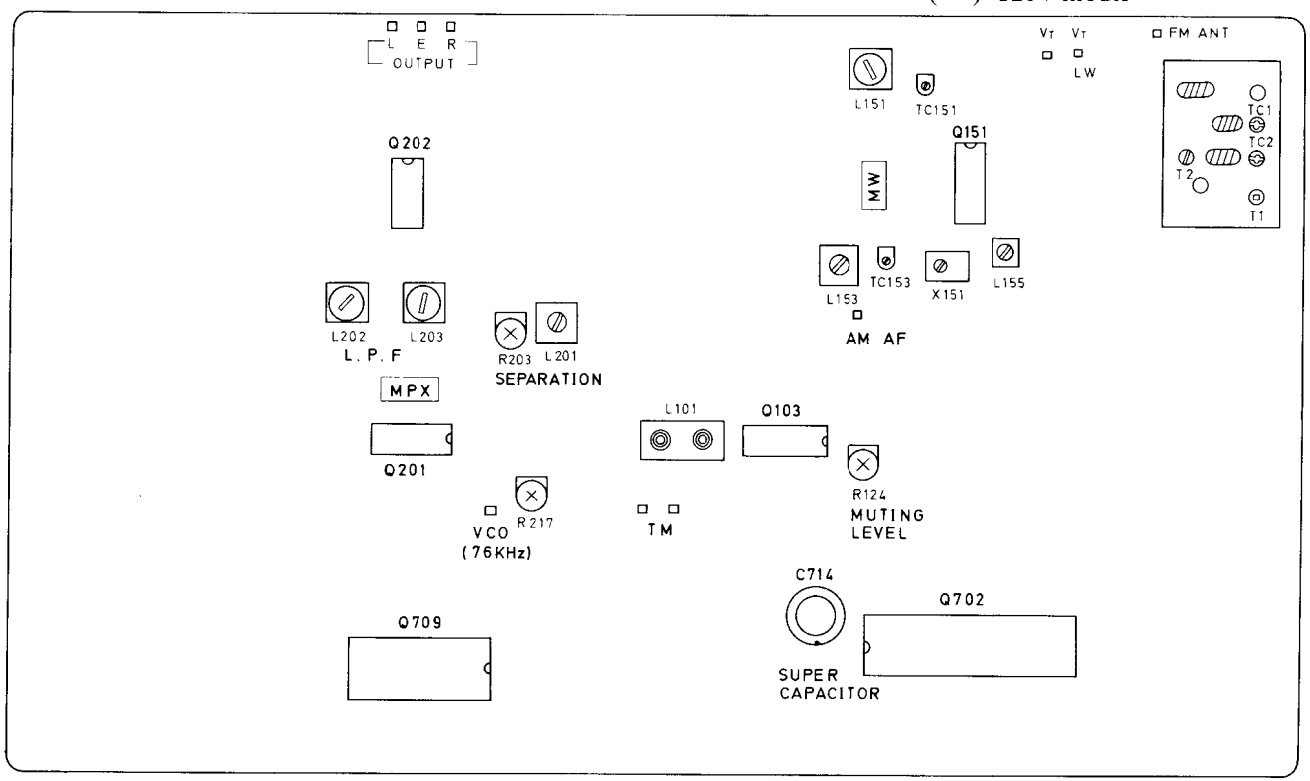
(fig. 3)

AM section

Step	AM SG output	Tuned frequency	Output indicator	Adjustment point	Adjust for	Remarks
1	999kHz (1000kHz) 400Hz 30% mod.	999kHz (1000kHz)	AC voltmeter	X151 L155	Maximum	
2		522kHz (520kHz)	Digital DC voltmeter	L153	0.8V	Repeat the steps 2 and 3 until no further adjustment is necessary.
3		1611kHz (1610kHz)	Digital DC voltmeter	TC153	9.0V	
4	603kHz (600kHz) 400Hz 30% mod.	603kHz (600kHz)	AC voltmeter	L151	Maximum	Repeat the steps 4 and 5 until no further adjustment is necessary.
5	1404kHz (1404kHz) 400Hz 30% mod.	1404kHz (1400kHz)	AC voltmeter	TC151	Maximum	

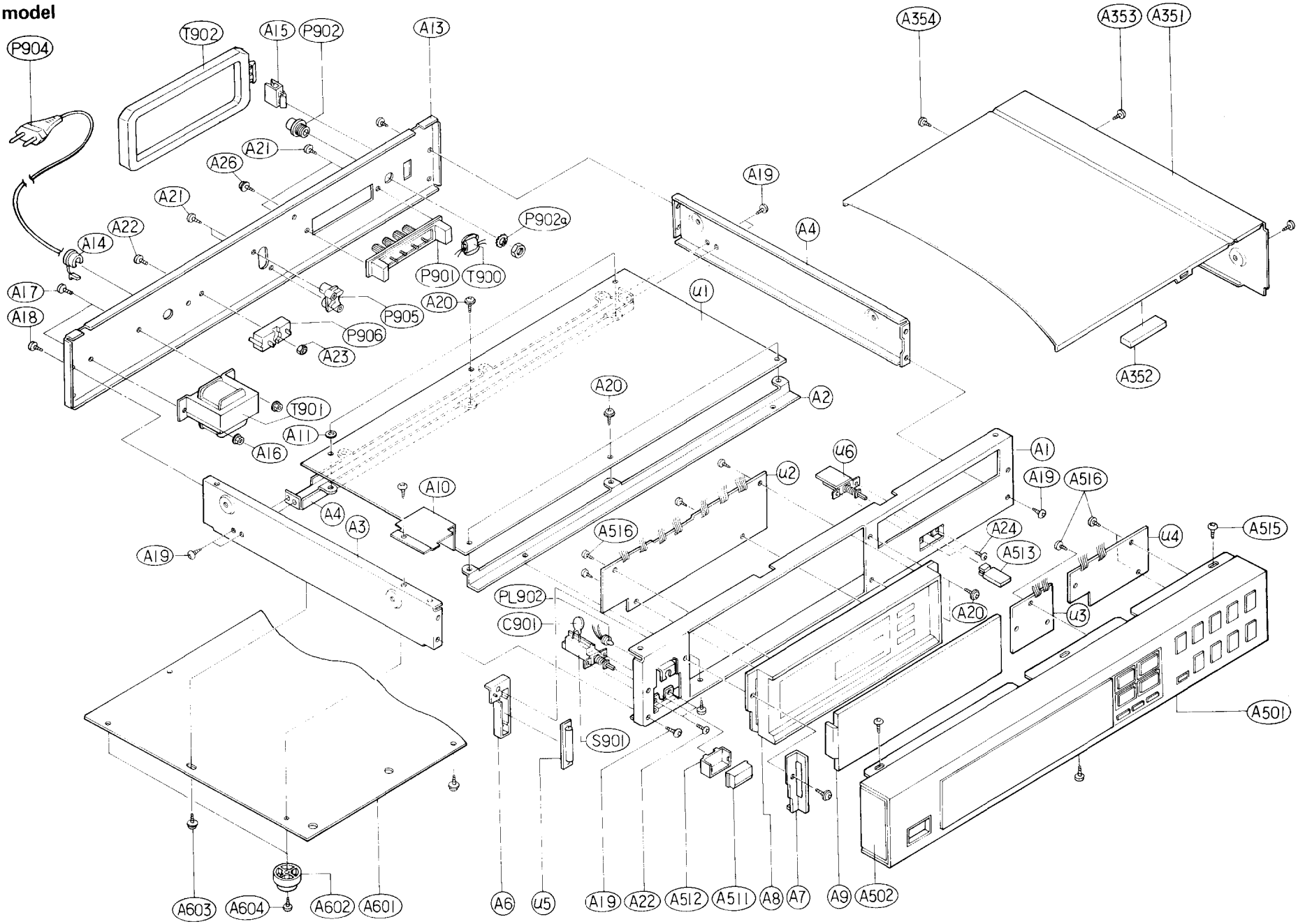
( ): 120V model





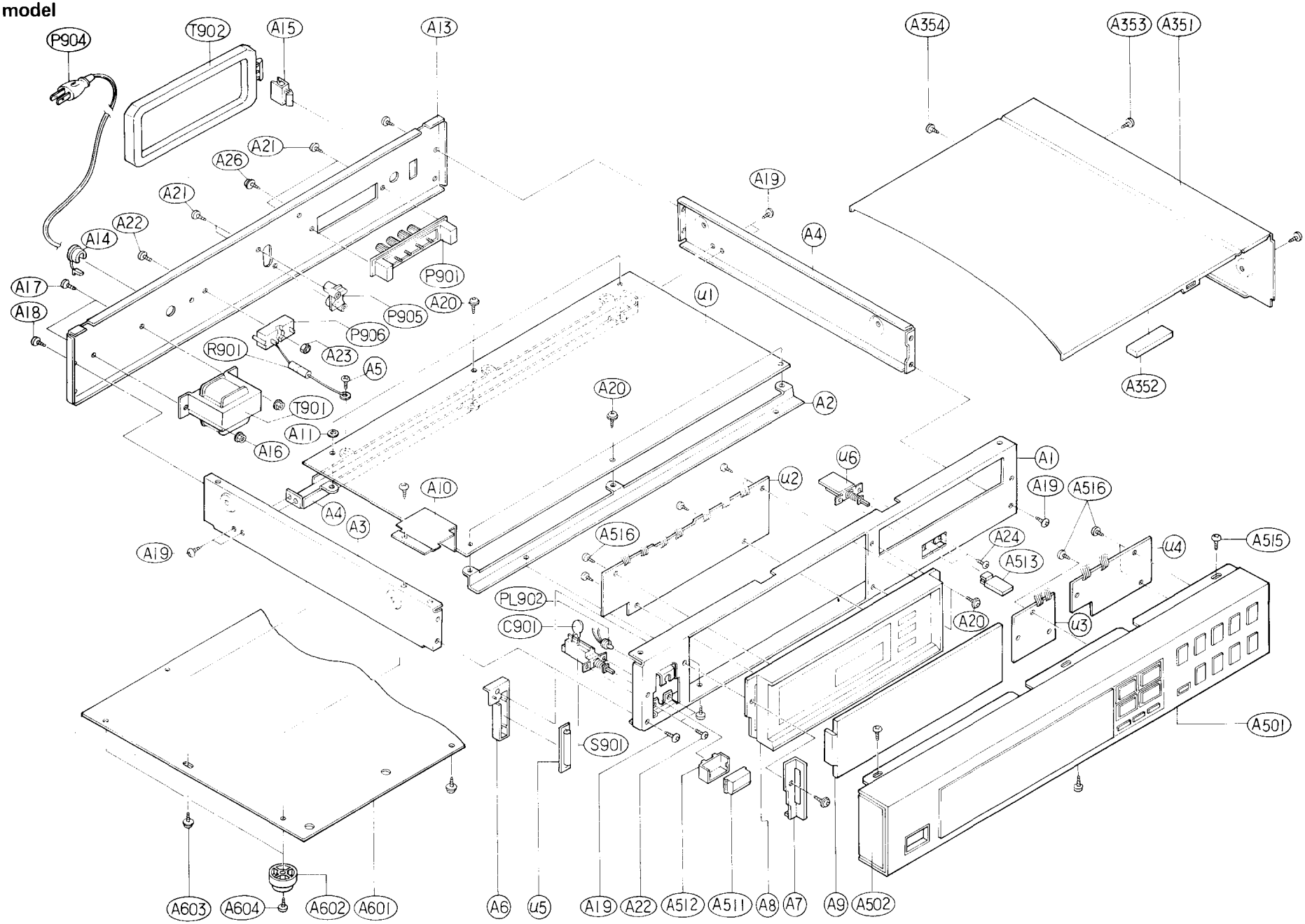
EXPLODED VIEW

G model



EXPLODED VIEW

D model



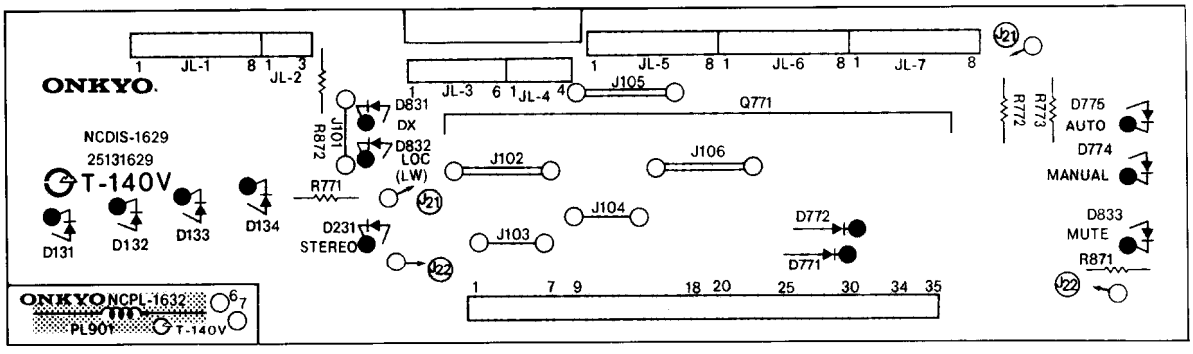
PARTS LIST

REF. NO.	PARTS NO.	DESCRIPTION
A1	27110194B	Front bracket
A2	27130332	Bracket F
A3	27115014F	Side bracket
A4	27130333	Bracket M
A5	833130088	3TTW+8B, Tapping screw (D)
A6	27190198	Holder, lamp
A7	27190197	Holder, dial plate
A8	27133073-1A	Back plate
A9	28130181A	Dial plate
A10	28175073-1	Insulating plate
A11	870060	W3x15mm, Special washer
A13	27120476A	Back panel (D)
	27120477A	Back panel (G)
	27120478	Back panel (W)
⚠ A14	270025	SR-3P-4, Strainrelief (D)
⚠	270280	SR-4K-4, Stainrelief (G/W)
A15	27190129	Antenna holder
A16	86414010	FWN4x10FN, Flange nut
A17	838440089	4TTB+8C (BC), Tapping screw
A18	801230	3STS+8BQ (BC), Tapping screw
A19	834430068	3TTS+6B (BC), Tapping screw
A20	831430088	3TTW+8B (BC), Tapping screw
A21	834430108	3TTS+10B (BC), Tapping screw
A22	82143006	3P+6FN (BC), Pan head screw
A23	863430	N-3F-N (BC), Nut
A24	82142004	2P+4F (BC), Pan head screw
A26	834230108	3TTS+10B (Ni), Nickel screw
A351	28184188	Top cover
	28184183	Top cover (B)
A352	28140020	4x10x40mm, Cushion
A353	838440089	4TTB+8C (BC), Tapping screw
A354	834430068	3TTS+6B (BC), Tapping screw
A501	13138121	Front panel ass'y
	13124121	Front panel ass'y (B)
A502	28125137	End cap
	28125138	End cap
A509	28321059B	Tuning knob ass'y
	28321060B	Tuning knob ass'y (B)
A510	28321069B	Preset knob ass'y
	28321070B	Preset knob ass'y (B)
A511	28321023	Knob, power
	28321024	Knob, power (B)
A512	28320828B	Base, knob
A513	28321073	Knob, band
	28321074	Knob, band (B)
A515	834430068	3TTS+6B (BC), Tapping screw
A516	833430080	3TTP+8P (BC), Tapping screw
A518	28140486	Cushion
A601	27170151A	Bottom board
A602	27175009A	Leg
A603	831430088	3TTW+8B (BC), Tapping screw
A604	834430108	3TTS+10B (BC), Tapping screw
⚠C901	3500065A	DE7150FZ103PAC 400V/125V, Capacitor IS
C901a	27300080	Cover, capacitor
P901	25060047	NTM-4PRMN16, Antenna terminal
P902	25045088	Connector, antenna FM (75Ω) (G)
P902a	870057	M10B, Toothed washer
⚠ P904	253099A	AS-UC-3, Power supply cable (D)
⚠	253083-1	AS-CEE, Power supply cable (G/W)
P905	25045086	NPJ-2PRBL-43, Output terminal
⚠ P906	25108010	Terminal, AC primary
PL902	210149	PL14V0.06AW-3.0, Power indicator lamp
⚠ R901	431523355	3.3MΩ, 1/2W, Solid resistor (D)
⚠ S901	25035135	NPS-111-L100P, Power switch (D)
⚠	25035322 or	NPS-111-L286 or
⚠	25035176	NPS-111-L140, Power switch (G/W)
⚠ S902	25065123	NSS-1258P, Voltage selector switch (W)
⚠ T901	230683	NPT-806D, Power transformer (D)
⚠ T901	230684	NPT-806G, Power transformer (G)
⚠	230685	NPT-806DG, Power transformer (W)
T900	233026A	NBLN-1, Balloon transformer (G)
T902	232098	NMA-3040, AM loop antenna
U1	13138528	NARF-1628, FM/AM tuner and controller pc board ass'y (D)
	13144528A	NARF-1628a, FM/AM tuner and controller pc board ass'y (G)
	13140528B	NARF-1628b, FM/AM tuner and controller pc board ass'y (W)
U2	13138529	NADIS-1629, Fluorescent indicator tube pc board ass'y (D)
	13144529A	NADIS-1629a, Fluorescent indicator tube pc board ass'y (G/W)
U3	13138530	NASW-1630, Switch pc board ass'y
U4	13138531	NASW-1631, Switch pc board ass'y
U5	13138532	NAPL-1632, Lamp pc board ass'y
U6	13138533	NASW-1633, AGC switch pc board ass'y

Note: (D); Only 120V model
(G); Only 220V model
(W); Only 120/220V model
(B); Only black model

NOTE: THE COMPONENTS IDENTIFIED BY MARK ⚠ ARE CRITICAL FOR LISK OF FIRE AND ELECTRIC SHOCK. REPLACE ONLY WITH PARTS NUMBER SPECIFIED.

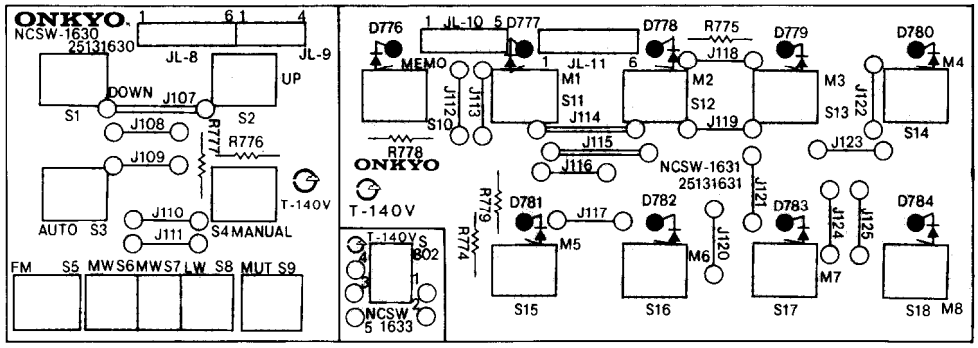
PRINTED CIRCUIT BOARD VIEW FROM COMPONENT SIDE



FLUORESCENT INDICATOR TUBE PC BOARD (NADIS-1629/a/b)

CIRCUIT NO.	PARTS NO.	DESCRIPTION
	Fluorescent indicator tube	
Q771	212016	FIP7B8CS
	L.E.Ds	
D131-D134	225137	SEL2413E
D231, D774	225142	SEL2913K
D775, D831	225137	SEL2413E
D832, D833	225142	SEL2913K
	Diodes	
D771, D772	223105, 223133 or 223145	1S1555, DS442X or 1S2076TD (G/W)
	Holder	
	27190199B	
	Cushion	
	28140417	

Note: (G); Only 220V model
(W); Only 120/220V model



SWITCH PC BOARDS (NASW-1630/1631/1633)

CIRCUIT NO.	PARTS NO.	DESCRIPTION
	(NASW-1630)	
	Switches	
S7, S9	25035275	NPS-111-S239
	(NASW-1631)	
	L.E.Ds	
D776-D784	225126	GL3PR1
	Switches	
S10-S18	25035275	NPS-111-S239
	Spacers	
	27270103	
	(NASW-1633)	
	25035377	NPS-122-L341

LAMP PC BOARD (NAPL-1632)

CIRCUIT NO.	PARTS NO.	DESCRIPTION
PL901	210064A	250mA, 6.3V, Lamp

PRINTED CIRCUIT BOARD-PARTS LIST

G/W model

FM/AM TUNER AND CONTROLLER PC BOARD (NARF-1628a/b)

CIRCUIT NO.	PARTS NO.	DESCRIPTION
	Front end	
TU001	240059	FE416U33 (G)
TU001	240061	FE349U14 (W)
	ICs	
Q103	222608	μPC1167C2, FM IF system
Q104	222666	LB1403, Signal strength indicator driver
Q151	222626	HA-1197, AM radio system
Q201	222453	HA-1196, Stereo decoder
Q202	222575 or 222840661	TC4066BP or 4066B, Analogue switch

EXPLODED VIEW

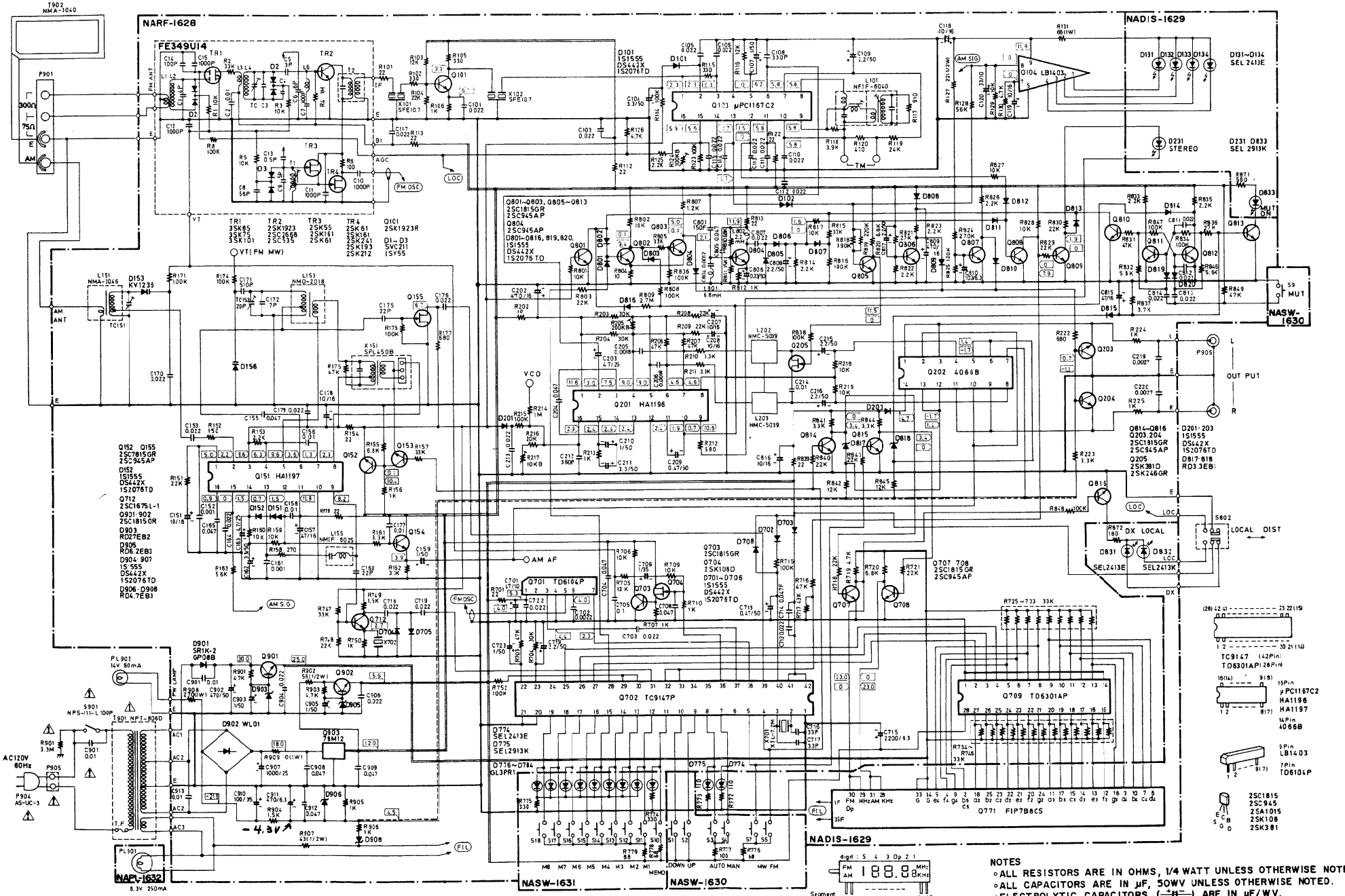
CIRCUIT NO.	PARTS NO.	DESCRIPTION
Q701	222675	TD6104P, Prescaler
Q702	222674	TC9147P, Synthsizer and controller
Q709	222673	TD6301AP, Frequency indicator driver
Q903	222780122	78M12, Constant voltage
	Transistors	
Q101	2211722	2SC1923 (R)
Q102	2210823	2SC1675 (L-1) (G)
Q152-Q154	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q155	2212304 or	2SK381 (D) or
	2211945	2SK246 (GR)
Q203, Q204	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q205	2212304 or	2SK381 (D) or
	2211945	2SK246 (GR)
Q703	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q704	2212294	2SK108 (D)
Q707, Q708	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q710	2211455	2SA1015 (GR)
Q711, Q713	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q712	2210823	2SC1675 (L-1)
Q801-Q803	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q804	2210746	2SC945A (P)
Q805-Q816	2210746 or	2SC945A (P) or
	2211255	2SC1815 (GR)
Q901, Q902	2211255	2SC1815 (GR)
	Diodes	
D101, D152	223105,	1S1555,
	223133 or	DS442X or
	223145	1S2076TD
D102, D151	4000068	VD1222
D103	223955 or	RD8.2EB or
	224103	GZA-8.2L (G)
D153, D154	223140	KV1236
D201, D203	223105,	1S1555,
D702-D706	223133 or	DS442X or
D708	223145	1S2076TD
D801-D816	223105,	1S1555
	223133 or	DS442X or
	223145	1S2076TD
D817, D818	2241291	RD3.3EB1
D819, D820	223105,	1S1555,
	223133 or	DS442X or
	223145	1S2076TD
D901	223804 or	SR1K-2 or
	223848	GP08B
D902	223862	WL01
D903	2239792	RD27EB2
D905	2239493	RD6.2EB3
D906	2239433	RD4.7EB3
D907	223105,	1S1555,
	223133 or	DS442X or
	223145	1S2076TD
D908	2239433	RD4.7EB3
	Transformers and coils	
L101	233270	NFIF-6040
L151	232112 or 3	NMA3048 or 9
L153	232084	NMO-2018
L155	232095	NIT-6025
L201	233236	NMC-6027 (G)
L202, L203	233291	NMC-5039
L801	233122	NCH-3013
L802	233031	NMC-9-1

CIRCUIT NO.	PARTS NO.	DESCRIPTION
	Ceramic filters	
X101-X103	3010043	SFE10.7MM (G)
X101, X102	3010006	SFE10.7MA (RED) (W)
X151	3010075	SFL450B3
X702	3010076	BFU450C
	X'tal	
X701	3010073	XTL-7.2M
	Capacitors	
C104	352780339	3.3μF, 50V, Elect.
C107	352780109	1μF, 50V, Elect.
C109	352780229	2.2μF, 50V, Elect.
C118, C119	352741009	10μF, 16V, Elect.
TC151, TC153	3060010	NTC20P09, Trimmer
C151	352741009	10μF, 16V, Elect.
C157	352744709	47μF, 16V, Elect.
C159	352780109	1μF, 50V, Elect.
C162	352780339	3.3μF, 50V, Elect.
C163	352750479	4.7μF, 25V, Elect.
C171	370135114	510pF±5%, 100V, APS
C178	352741009	10μF, 16V, Elect.
C202	352744719	470μF, 16V, Elect.
C203	352750479	4.7μF, 25V, Elect.
C207, C208	352741009	10μF, 16V, Elect.
C209	352784799	0.47μF, 50V, Elect.
C210	352780109	1μF, 50V, Elect.
C211	352780339	3.3μF, 50V, Elect.
C212	372523614	360pF±5%, 50V, Styrol
C215, C216	352780229	2.2μF, 50V, Elect.
C701	352734709	47μF, 10V, Elect.
C706	395160107	1μF, 35V, Tantalum
C713	352784799	0.47μF, 50V, Elect.
C714	3020018	0.047F, 5V, Super
C715	352722229	2,200μF, 6.3V, Elect.
C719, C723	352780109	1μF, 50V, Elect.
C806	352783399	0.33μF, 50V, Elect.
C808	352780229	2.2μF, 50V, Elect.
C809	352744719	470μF, 16V, Elect.
C810	352721019	100μF, 6.3V, Elect.
C815	352744709	47μF, 16V, Elect.
C816	352741009	10μF, 16V, Elect.
C817	352780479	4.7μF, 50V, Elect. (G)
	352780229	2.2μF, 50V, Elect. (W)
C902	352784719	470μF, 50V, Elect.
C903, C905	352780109	1μF, 50V, Elect.
C907	352751029	1,000μF, 25V, Elect.
C910	352761019	100μF, 35V, Elect.
C911	352724719	470μF, 6.3V, Elect.
	Resistors	
R113	441521014	100Ω, 1/2W, Metal oxide film (G)
R124	5215047	N08HR100KBC, Semi-fixed
R127	441522204	22Ω, 1/2W, Metal oxide film
R131	441626804	68Ω, 1W, Metal oxide film
R205	5215048	N08HR200KBC, Semi-fixed
R217	5215045	N08HR10KBC, Semi-fixed
R725-R733	49121333509	33kΩx9, Network
R734-R746	49121333513	33kΩx13, Network
R902	441525604	56Ω, 1/2W, Metal oxide film
R907	441524304	43Ω, 1/2W, Metal oxide film
R908	441622714	270Ω, 1W, Metal oxide film
R909	441621004	10Ω, 1W, Metal oxide film
	Switches	
S201, S701	250142	NSS-2225, De-emphasis/AM scan step (W)

Note: G ; Only 220V model
W ; Only 120/220V model

SCHEMATIC DIAGRAM

D model



NOTES

- ALL RESISTORS ARE IN OHMS, 1/4 WATT UNLESS OTHERWISE NOTED.
- ALL CAPACITORS ARE IN μF, 50WV UNLESS OTHERWISE NOTED.
- ELECTROLYTIC CAPACITORS (⊣⊢) ARE IN μF/WV.
- VOLTAGE (MEASURED WITH V.T.V.M.) (NO INPUT SIGNAL).
- CIRCUIT IS SUBJECT TO CHANGE FOR IMPROVEMENT.
- THE COMPONENTS IDENTIFIED BY MARK ⚠ ARE CRITICAL FOR SAFETY. REPLACE ONLY WITH PART NUMBER SPECIFIED.

PRINTED CIRCUIT BOARD-PARTS LIST

D model

FM/AM TUNER AND CONTROLLER PC BOARD (NARF-1628)

CIRCUIT NO.	PARTS NO.	DESCRIPTION
	Front end	
TU001	240061	FE349U14
	ICs	
Q103	222608	μPC1167C2, FM IF system
Q104	222666	LB1403, Signal strength indicator driver
Q151	222626	HA-1197, AM radio system
Q201	222453	HA-1196, Stereo decoder
Q202	222575 or 222840661	TC4066BP or 4066B, Analogue switch
Q701	222675	TD6104P, Prescaler
Q702	222674	TC9147P, Synthsizer and controller
Q709	222673	TD6301AP, Frequency indicator driver
Q903	222780122	78M12, Constant voltage
	Transistors	
Q101	2211722	2SC1923 (R)
Q152-Q154	2210746 or 2211255	2SC945A (P) or 2SC1815 (GR)
Q155	2212304 or 2211945	2SK381 (D) or 2SK246 (GR)
Q203, Q204	2210746 or 2211255	2SC945A (P) or 2SC1815 (GR)
Q205	2212304 or 2211945	2SK381 (D) or 2SK246 (GR)
Q703	2210746 or 2211255	2SC945A (P) or 2SC1815 (GR)
Q704	2212294	2SK108 (D)
Q707, Q708	2210746 or 2211255	2SC945A (P) or 2SC1815 (GR)
Q712	2210823	2SC1675 (L-1)
Q801-Q803	2210746 or 2211255	2SC945A (P) or 2SC1815 (GR)
Q804	2210746	2SC945A (P)
Q805-Q816	2210746 or 2211255	2SC945A (P) or 2SC1815 (GR)
Q901, Q902	2211255	2SC1815 (GR)
	Diodes	
D101, D152	223105, 223133 or 223145	1S1555, DS442X or 1S2076TD
D102, D151	4000068	VD1222
D153, D154	223140	KV1236
D201, D203 D702-D706 D708	223105, 223133 or 223145	1S1555, DS442X or 1S2076TD
D801-D816	223105, 223133 or 223145	1S1555, DS442X or 1S2076TD
D817, D818	2241291	RD3.3EB1
D819, D820	223105, 223133 or 223145	1S1555, DS442X or 1S2076TD
D901	223804 or 223848	SR1K-2 or GP08B
D902	223862	WL01
D903	2239792	RD27EB2
D905	2239493	RD6.2EB3
D906	2239433	RD4.7EB3
D907	223105, 223133 or 223145	1S1555, DS442X or 1S2076TD
D908	2239433	RD4.7EB3

CIRCUIT NO.	PARTS NO.	DESCRIPTION
	Transformers and coils	
L101	233270	NFIF-6040
L151	232112 or 3	NMA-3048 or 9
L153	232084	NMO-2018
L155	232095	NIT-6025
L202, L203	233291	NMC-5039
L801	233122	NCH-3013
L802	233031	NMC-9-1
	Ceramic filters	
X101-X102	3010006	SFE10.7MA (RED)
X151	3010075	SFL450B3
X702	3010076	BFU450C
	X'tal	
X701	3010073	XTL-7.2M
	Capacitors	
C104	352780339	3.3μF, 50V, Elect.
C107	352780109	1μF, 50V, Elect.
C109	352780229	2.2μF, 50V, Elect.
C118, C119	352741009	10μF, 16V, Elect.
TC151, TC153	3060010	NTC20P09, Trimmer
C151	352741009	10μF, 16V, Elect.
C157	352744709	47μF, 16V, Elect.
C159	352780109	1μF, 50V, Elect.
C162	352780339	3.3μF, 50V, Elect.
C163	352750479	4.7μF, 25V, Elect.
C171	370135114	510pF±5%, 100V, APS
C178	352741009	10μF, 16V, Elect.
C202	352744719	470μF, 16V, Elect.
C203	352750479	4.7μF, 25V, Elect.
C207, C208	352741009	10μF, 16V, Elect.
C209	352784799	0.47μF, 50V, Elect.
C210	352780109	1μF, 50V, Elect.
C211	352780339	3.3μF, 50V, Elect.
C212	372523614	360pF±5%, 50V, Styrol
C215, C216	352780229	2.2μF, 50V, Elect.
C701	352734709	47μF, 10V, Elect.
C706	395160107	1μF, 35V, Tantalum
C713	352784799	0.47μF, 50V, Elect.
C714	3020018	0.047F ,5V, Super
C715	352722229	2,200μF, 6.3V, Elect.
C723	352780109	1μF, 50V, Elect.
C806	352783399	0.33μF, 50V, Elect.
C808, C719	352780229	2.2μF, 50V, Elect.
C809	352744719	470μF, 16V, Elect.
C810	352721019	100μF, 6.3V, Elect.
C815	352744709	47μF, 16V, Elect.
C816	352741009	10μF, 16V, Elect.
C817	352780229	2.2μF, 50V, Elect.
C902	352784719	470μF, 50V, Elect.
C903, C905	352780109	1μF, 50V, Elect.
C907	352751029	1,000μF, 25V, Elect.
C910	352761019	100μF, 35V, Elect.
C911	352724719	470μF, 6.3V, Elect.
	Resistors	
R124	5215047	N08HR100KBC, Semi-fixed
R127	441522204	22Ω, 1/2W, Metal oxide film
R131	441626804	68Ω, 1W, Metal oxide film
R205	5215048	N08HR200KBC, Semi-fixed
R217	5215045	N08HR10KBC, Semi-fixed
R725-R733	49121333509	33kΩx9, Network
R734-R746	49121333513	33kΩx13, Network
R902	441525604	56Ω, 1/2W, Metal oxide film
R907	441524304	43Ω, 1/2W, Metal oxide film
R908	441622714	270Ω, 1W, Metal oxide film
R909	441621004	10Ω, 1W, Metal oxide film